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(54) A DEVICE FOR PAPER-MAKING OR WET-PULP MACHINES

(71) We, LEDER- UND RIEMEN-PATENTVERTUNGSGESELLSCHAFT M.B.H., of Mariahilferstrasse 135, Vienna 15, Austria, an Austrian Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a device for paper-making or wet-pulp machines.

In paper-making machines, parts such as suction plates or suction-box covers suction bars, forming boards. doctors and foil bars which are in sliding contact with the wire or the felt are subjected to a high degree of stress and wear. When these components exert an abrasive effect on the wire or on the felt, the service life of the latter is shortened. Attempts have been made therefore to provide these components with soft surfaces, but this in turn shortened their service life. The necessary replacement or repair operation leads to a shutdown of the machine, which is clearly disadvantageous. For this reason, attempts have already been made to use very hard materials in the manufacture of the components which come into sliding contact with the wire. When the hardness is high enough to make wear practically negligible, the permanent smoothness of the contact surface is ensured, thereby substantially reducing the wear on the wire. For example, oxide ceramics have been proposed as material for machine parts coming into sliding contact with the wire. However, such hard materials are also very brittle and there arises the drawback that lining made of such materials tend to break when the support is not wholly resistant to distortion. If such a break occurs during operation, the sharp broken edges of the hard material cause heavy damage to or destroy the wire, before the machine can be stopped, thus interrupting operation.

The invention consists in a device for extracting water from the paper or pulp in a paper-making or wet-pulp machine, said device having an upper surface for sliding cooperation with the wire or felt of the machine, at least a substantial part of the surface being formed by elements made of hard oxide ceramic material, which elements are embedded into or supported by support means made of a water-repellent non-brittle synthetic plastics material which is softer than the oxide ceramic material.

By this subdivision into elements and the supporting effect of the softer material the danger of breakage due to blows or torsional stresses is reduced. In this manner, the advantages of the hard and brittle materials can be fully exploited, without having to fear the disadvantages arising from their brittleness. The support member may be made of polyethylene, in particular sintered low-pressure polyethylene of high molecular weight, e.g. 1,000,000. Oxide ceramics are particularly hard materials and have advantageous sliding properties relative to the wire. An oxide ceramic is prepared in a known manner by chemically purifying very fine aluminium powder, optionally with addition of chromium compounds and oxidizing it thereafter. The resulting aluminium oxide powder is mixed with an organic binder and is then compressed in a mold at about 1000 atmospheres pressure to such an extent that a pressed body results whose specific gravity is greater than that of the aluminium powder. This pressed body is then fired in a furnace at 1700—2000°C, following which the finished article has a hardness of 9 (diamond=10). Oxide ceramics have the drawback of being very brittle, but this drawback is overcome by the embedding into the elastic plastics material. According to a further development the oxide ceramic elements may be arranged at those zones of the components which are particularly subject to wear, particularly in the region of their leading and/or trailing edges. This arrangement substantially reduces the wear of the components, because those regions which are otherwise the first to show signs of wear are now covered by the hard, wear-resistant elements, whose wear-resistance is substantially higher than that of the softer supporting material. Such wear occurs in paper-making machines for example when the pulp is admixed with kaolin, where the addition may be as high as 30%. Under certain operating conditions the kaolin may penetrate into the surface of those machine parts which are swept by the wire; consequently, the surface loses its smoothness and becomes roughened, the kaolin acting as an abrasive. Owing to this abrasive action the components swept by the wire in the known constructions are very rapidly worn out, so that the operation must soon be interrupted in order to replace these components. Since the oxide ceramic elements are substantially harder than glass, the invention prevents damage to the highly polished surfaces of the components cooperating with the wire or felt by the kaolin possibly carried by said wire or felt. The very low coefficient of friction between wire or felt on one hand and the surface of the components on the other is preserved during operation, so that for a given wire size the operation can be carried out at a higher wire speed during the whole of the service life of the components. This also leads to an increase in machine output.

Experience has shown, that the leading and/or trailing edges of components such as suction-box covers, suction bars, forming boards, doctors, foil bars, are subjected to a particularly intense wear, the apparent reason being that the wire or the felt, even if considerably pre-stressed, will always sag to some extent between adjacent components, so that the greatest wear will occur precisely on the edges of the components.

In the case of suction-box covers, wire-table liners and suction bars it will suffice in most cases to arrange the hard elements at a slight distance from the leading and/or trailing edge, i.e. so that the leading or trailing edge proper consists of a softer material, e.g. sintered low-pressure polyethylene. Although in the course of operation this leads to a certain rounding of these edges as far as the position of the hard elements, this rounding can be tolerated in such components. In the case of doctors, foil bars, where the preservation of the sharp leading or trailing edges is important, it will be more advantageous to constitute said edges of oxide ceramics in accordance with the invention.

Preferably the leading and/or trailing edges are formed of strips of oxide ceramics, placed on or embedded into the support material and subdivided across the direction of travel of the wire or felt. Such a positioning or embedding can be easily effected with the aid of grooves, e.g. dovetail grooves. The subdivision of the strips prevents them from breaking when the components are distorted or sag in operation (e.g. under the effects of the vacuum.

In the case of small components (measured in the direction of travel of the wire or of the felt), the entire covering surface, i.e. the surface cooperating with the wire or felt can be formed of an oxide ceramic material. This type of construction may be employed in the case of suction bars, doctors and foil bars. However, for broader components it will be advisable for reasons of economy to provide oxide ceramic strips only in the region of the leading and/or trailing edges and to relieve these by means of further oxide ceramic parts, in particular parts extending obliquely to the direction of travel of the wire or felt and having the form of strips. As it is, suction box covers or forming boards often measure 50 cm or more in width, so that now the wire or felt will be supported also in those relatively broad zones located between the leading edge and the trailing edge or between the oxide ceramic strips positioned in the regions of these edges. In this manner, the hard oxide ceramic parts will be able to absorb without difficulty even high vacuum which may lead to a load of several tons on the suction-box lid, and prevent a high degree of wear of the soft supporting material which would otherwise occur due to the tight contact of the surface of the latter with the wire.

With suction box covers or forming boards of large surface area, in recent times, perforated plates have been increasingly replaced by slotted plates, in order to facilitate the evacuation of the larger volumes of water resulting from the increased wire speeds (up to 600 metres/minute). Such slotted plates cannot be formed of oxide ceramics in a single piece, since the width of the wire, often amounting to several metres, is greater than the length of an oxide ceramic element which could be produced without warping. Nor could such plates be composed of individual oxide ceramic strips, since the draining slots which traverse the entire width of the machine would divide the producible liner element into several disconnected pieces. It would be equally impossible to provide in the oxide ceramic strips slots extending obliquely to the direction of travel of the wire or felt, because the thin webs remaining between the slots would become so warped during the firing process as to make the economic manufacture of such segments impracticable. These difficulties can be avoided by means of the invention, by forming the leading and preferably also the trailing edges of at least some of the slots of oxide ceramic elements carried by the rigid support. In this manner, a base plate constituting the support which may be integral or composed of a plurality of segments will have arranged thereon covering or imbedded elements made of a hard material, which line the slot edges. This makes it possible to construct the support plate, which may not absorb any moisture, must be warp-proof and, if it has regions cooperating with the wire or felt, must have a low coefficient of friction relative to the wire or felt, in such a manner that said base is capable of withstanding both the pressure and the thrust exerted by the wire or felt. Above all, however, the oxide ceramic elements need not be produced in complicated shapes, but can have a simple and uniform cross-section over their entire length. Consequently, these oxide ceramic elements will be much less subject to warping during their manufacture and will also require substantially less working which, owing to their hardness, is in practice only possible by grinding with diamond wheels. This leads to savings in work and materials. In larger plates, a plurality of oxide ceramic strips, as viewed perpendicularly to the direction of wire or felt travel, extend adjacent to each other, where the joints between adjoining strips extend obliquely to the direction of travel of the wire or felt. In this manner, oxide ceramic liners of any desired length can be assembled, while avoiding any marking of the pulp by joints extending parallel to the direction of wire or felt travel.

Preferably the surface of the webs separating the adjacent slots is also formed of oxide ceramic elements. In this manner, the whole of the plate surface cooperating with the wire or felt can be constituted of oxide ceramic elements, so that the support does not come into contact at all with the wire or the felt. Consequently, the choice of the support material will not be influenced by the coefficient of friction relative to the wire or to the felt, thus offering a greater latitude in the selection of the support material.

From a certain length onwards, the thermal expansion properties of the oxide ceramic elements must be taken into consideration, especially when these elements are in the shape of strips or when several such strips are arranged abutting each other. The coefficient of thermal expansion of the oxide ceramics is in general substantially smaller than that of the support material, especially when the latter consists of sintered low-pressure polyethylene. Therefore, according to a further development of the invention, the oxide ceramic elements, especially those of a certain length, are connected with the support in the manner of an expansion joint. This is achieved expediently by providing the oxide-ceramic element and/or the support with a groove extending along the oxide ceramic element, in which the means for fastening said element to the support engage with a certain play. To prevent an expansion of the support resulting in the individual adjoining oxide ceramic elements being pulled away from each other by frictional entrainment, forming gaps between adjacent elements, into which pulp could be deposited, the strip-shaped oxide ceramic elements, according to the invention, are resiliently pressed against each other end to end. In a particularly advantageous embodiment this is achieved by a tensioning bar which passes through all adjoining oxide ceramic elements extending across the direction of wire or felt travel, while springs supported on the said tensioning bar press the oxide ceramic elements against each other and the spring load acting from both sides is greater than the force necessary to displace an oxide ceramic element on the support. Thus, the tensioning bar acts ont only to hold the oxide ceramic elements down onto the support, but also as a tensile element which absorbs the traction exerted by aforesaid springs.

The springs may be constituted by spring disks or plate springs or rubber blocks mounted in sufficient numbers on the threaded ends of the tensioning bar and made fast therewith by means of nuts. By this means, the thermal expansion differences which, for an assumed operational temperature difference of 50°C may amount to 0.5 mm/metre and thus for a machine with a 4 metre broad wire add up to 2 mm, can be easily compensated. The invention further offers the advantage that it will not be necessary, as with the known constructions, to transport entire machine sections, thus for example warp-proof suction boxes, into a ceramic factory to effect there the lining with the oxide-ceramic elements; rather, it is now possible, after releasing the pre-stress of the individual oxide ceramic elements, to transport and to mount the individual components without any risk of damage, whereafter they can be assembled and adjusted.

The invention will now be explained with reference to the accompanying drawings, which illustrate the invention but in no restrictive sense.

Figs. 1 and 2 each illustrate a suction box cover in perspective view;

Fig. 3 is a cross-section through an oxide ceramic element seated in a suction box cover;

Fig. 4 shows a staggered arrangement of the oxide ceramic elements in a suction box cover;

Fig. 5 shows a modified suction box cover;

Figs. 6 and 7 illustrate a modified form of the oxide ceramic elements in a suction plate, in plan view and in cross-section respectively;

Fig. 8 shows a foil bar;

Figs. 9, 10 and 11 illustrate different embodiments of the individual elements of a foil bar according to Fig. 8, in top view;

Fig. 12 is a top view of a part of a further embodiment of a suction box cover;

Figs. 13—15 show modifications of the embodiments shown in Figs. 1 and 2, in each of which at least the leading edge of the suction box cover is fitted with oxide-ceramic elements;

Figs. 16 and 17 show two modified forms foil bar;

Fig. 18 is a top view of a slotted suction box cover;

Fig. 19 is a section takeen along the line XIX—XIX in Fig. 18;

Fig. 20 is a top view of another form of suction box cover;

Fig. 21 is a top view of a part of a further modification thereof;

Figs. 22 and 23 each show a section taken along a plane across a slot of the suction box cover;

Fig. 24 is a section taken along the line XXIV—XXIV of Fig. 18;

Fig. 25 is a section taken along the line XXV—XXV of Fig. 24;

Fig. 26 is a sectional view of the fastening of an oxide ceramic strip, taken along the line XXVI—XXVI of Fig. 27;

Fig. 27 is a view of Fig. 26 in the direction of the arrow XXVII;

Fig. 28 is a sectional view of a suction-box;

Fig. 29 illustrates an oxide ceramic strip fastened to the support so as to compensate for expansion;

Fig. 30 is a side elevation of a supporting bar, together with oxide ceramic strip, fastened to a suction box cover;

Figs. 31 and 32 are sections, taken respectively along the line XXXI—XXXI and XXXII—XXXII of Fig. 30;

Fig. 33 illustrates a modified embodiment, in longitudinal section through the oxide ceramic strip;

Figs. 34 and 35 show, in longitudinal section, two embodiments, in each of which two adjacent oxide ceramic strips are held down by one fastening element;

Fig. 36 is a longitudinal section through the oxide ceramic strip of another embodiment;

Fig. 37 is a section taken along the line XXXVII—XXXVII of Fig. 36;

Fig. 38 is a cross-section through an embodiment of the fastening of the oxide ceramic strip;

Fig. 39 is a section taken along the line XXXIX—XXXIX of Fig. 38;

Fig. 40 is a perspective view of a detail;

Fig. 41 is a section taken along the line XXXXI—XXXXI of Fig. 40;

Fig. 42 is a modification of the embodiment according to Fig. 39, and

Fig. 43 illustrates the invention as applied to a suction or wet-end suction bar.

In the embodiment of Fig. 1, the elements or segments 1 are seated in a support 2. These elements are square plates with suction apertures 3 and have at the bottom a neck member sunk into the material of the plate-shaped support.

The embodiment illustrated in Fig. 2 differs in that the elements 1 are wholly embedded into the support plate 2. The rim 4 of this support plate 2 is level with the surface of the elements 1, so that a smooth run-up of the wire on to elements 1 is ensured. The elements 1 are so spaced relative to each other that gaps 5 remain which are filled by the material of the support 2.

As Fig. 3 shows, each of the elements illustrated in Figs. 1 and 2 comprises a suction orifice 3. The elements are mushroom-shaped. The surface portion 6 is large in area, while the lower portion or neck 7 has a smaller cross-section. The bore 8 of the elements is flush with the bore 9 of support 2, and has a widened area at 10. The support material itself fills the gap 5 between the elements.

Fig. 4 shows an arrangement of such elements as shown in Figs. 1 to 3. The individual elements 1 are offset relative to the direction of travel of the wire indicated by the arrow a. This staggered arrangement produces blanks at the edges, which are filled out by narrower elements 11 made of hard material.

The embodiment of Fig. 5 comprises cylindrical elements 12 which, as shown in the cross-sectional view of Fig. 3 in connection with elements 1, can also be mushroom-shaped. The elements 12 of Fig. 5 are more widely spaced from each other in the support plate 2 than the arrangement shown in figure 1. Consequently, the wire again slides on the material of support plate 2, which is also suitable for use as a forming board, but wear is substantially prevented by the hard elements 12. In suction box covers, the surface portions remaining between or around the elements 12 even off the advantage of an improved vacuum effect.

The embodiment shown in Figs. 6 and 7 has elements 13 of hexagonal shape, which are arranged in the manner of a honeycomb structure. The construction is again similar to that of the arrangements according to Figs. 1 and 2, but in this case the honeycomb-like structure itself offsets the elements relative to the direction of travel of the wire, indicated by the arrow a.

The constructions according to Figs. 1—7 constitute suction box covers or forming boards. They can be manufactured in a simple manner by placing the elements face down on the smooth bottom of a mould, whereafter the material of the support plate 2 is filled in. The support plate 2 may for example be cast or it may consist of a sinterable material, in which case the sinterable powder is filled into the mold containing the elements 1, 12 or 13 and is then pressed at the sintering temperature. This applies for example to the manufacture of support 2 from sintered low-pressure polyethylene.

In all these cases, the elements 1, 12 or 13 may be interchangeable or elevationally adjustable. Cylindrical elements may be provided with a screw thread, so that they can be adjusted by simple rotation, e.g. to compensate for wear, or interchanged if necessary. In the case of elements of other than cylindrical shape, interchange or elevational adjustment can only be carried out by displacement.

The embodiment of Fig. 8 shows a foil bar 14, which by its rounded portion 15 forms a vacuum slot between wire and bar and has a doctor or scraper edge at 16. Reference 14 here designates the support, and a dovetail groove 17 accommodates the inserted oxide ceramic elements 18. The hard zone formed by these elements prevents wear on the support bar 14. In the embodiment of Fig. 8, the joints or gaps 19 between these elements 18 extend in straight lines.

Figs. 9, 10 and 11 show top views of varicus shapes which these gaps may have. Thus, Fig. 9 illustrates a step-like formation of the gap 19 between the elements 18. Fig. 10 shows obliquely extending gaps 19 and Fig. 11 the gap or slot 19 is arrow-shaped. The arrow a again indicates the direction of travel of the wire, relative to which the slots 19 are offset.

The arrangement of Fig. 12 is similar to that cf Fig. 1 or 2, but here the surfaces of each of the elements 1 are not square but rhombic. The essential feature is that in this case the joints 5′ formed between these elements extend obliquely to the direction of wire travel indicated by the arrow a, which ensures a smoother wire movement over these joints. As in the arrangement of Fig. 4, this arrangement also necessitates the use of filler pieces 20 along the edge, which may consist of the same material as the elements 1.

In all cases, the arrangement is such that the height of the elements is smaller than the thickness of the support as measured from the wire path surface to the underside, where in the case of suction box covers the support plate has a smooth lower face as a sliding contact surface. In this manner, the smooth underside of the suction box cover is maintained in the same manner as in the case of the conventional suction box covers.

In the case of the suction box cover shown in Fig. 13, square, oxide ceramic elements 1 are seated in a support 2 made of sintered low-pressure polyethylene. In the region reference 2′, which is the region of the leading edge, the wire passes on to the suction plate. This region 2′ is here reinforced by oxide ceramic elements 21 which, just like the elements 1, are embedded into the material of the support plate 2. The elements 21 are in spaced arrangement relative to each other, and their length, measured across the direction of wire travel, corresponds to the length of elements 1. However, the elements 21 are offset relative to the elements 1 by half the length of an element in each case, in order to distribute the effects of the joints located between elements 1, 21 as uniformly as possible on the wire. The elements 21 form a sharp leading edge, interrupted only by the joints between the individual elements, which leeading edge, referenced 22, remains substantially intact even after long periods of operation by reason of the great hardness of elements 21.

In the embodiment of Fig. 14, both the elements 21 and the elements 1 are wholly embedded into the support plate. The strip-shaped oxide ceramic elements 21 arranged in the region 2′ of the leading edge are in this case located at a slight distance from the leading edge 22 proper, so that although the latter will be somewhat rounded during operation, this will happen only to the extent defined by the adjacent boundary edge 23 of the elements 21. The latter are connected with the support plate 2 by means of a dovetail joint, while the gap 5 between the elements 1 and the gap 5′ between the elements 21 is filled out with the material of the support plate.

In the embodiment according to Fig. 15, two strips 24, 25 are provided in the region 2′ of the leading edge, said strips extending parallel to the leading edge 22. The leading edge 22 itself is formed by the strip 24. The two strips 24, 25 are subdivided, transversely to the direction of wire travel a, into discrete elements 21, which however are not in a spaced arrangement, but are in direct contact with each other in both of the strips 24 and 25. The butt joints of strip 25 are each offset relative to the butt joints of strip 24 by half of the length of an element 21. The strip 24 constitutes a reliable protection for the leading edge 22, while the strip 25 forms a bearing surface for the wire. Additionally, further strips 26 may be embedded into the material of the support plate 2, extending obliquely to the direction of wire travel a. These strips 26 are also subdivided into discrete elements 21. They terminate at the strip 25. The oblique arrangement relative to the direction a of wire travel offers the advantage that the strips do not mark the wire and that the wire runs up on to these strips gradually. To prevent lateral forces from becoming active on the wire, the strips 26 may also be arranged in a V-shaped array, as viewed in the direction a of wire travel. In any event, the strips 26 constitute additional bearing surfaces for the wire, so that the soft material of the support plate 2 will not be subjected to excessive wear by the wire passing over it, even if no oxide-ceramic elements 12 surrounding the suction orifices are used. Consequently, these inserts 12 may be omitted in this case.

The trailing edges will be expediently constructed in the same manner as the leading edges.

In the embodiment illustrated in Fig. 16, the doctor edge 16 of the foil bar is constituted by an oxide-ceramic strip 27, subdivided into discrete segments 18 which directly abut on each other. The joints 19′ between the individual elements 18 are V-shaped, so that they do not exert any lateral forces on the wire. The strip 27 as a whole is fastened by means of a dovetail joint to a support made of sintered low-pressure polyethylene, which in turn is secured by means of a dovetail joint 28 to a base 29.

In the modified embodiment shown in Fig. 17, the entire upper portion of the foil bar 14 is constituted by discrete, contiguous elements 18 of an oxide ceramic material, all of which are secured by means of dovetail joints 17 to a base 29 which may likewise consist of sintered low-pressure polyethylene.

Where dovetail joints are employed to connect the oxide ceramic elements with the support material, the subdivision of the oxide-ceramic components into discrete elements has the further advantage that these elements can be individually inserted into the dovetail grooves, so that in each case only the resistance offered by a single segment has to be overcome. However, the oxide ceramic parts could also be made fast with the support by means of a screw connection, especially in the case of the embodiments according to Figs. 16 and 17.

The oxide-ceramic elements 1 in Figs. 13—15 are expediently mushroom-shaped. However, it is not necessary to form each element 1 wholly of oxide ceramics. For reasons of economy it will be more advantageous to form only that surface portion of each element 1 of oxide ceramics which cooperate with the wire. The remainder of each mushroom-shaped element 1 may be constituted by e.g. a die-cast body, for example of aluminium, which is bonded with the oxide ceramic liner. Suitable bonding agents are for example synthetic resins, such as Araldite registered Trade Mark.

According to Fig. 18, the plate 51 constituting the support has several draining slots 53 arranged perpendicularly to the direction of wire travel (arrow a), which extend substantially over the whole length of plate 51, as measured perpendicularly to the direction a of wire travel. The individual slots 53 are separated by webs 54, which are supported by reinforcements 55 (Figs. 18, 19) in a staggered arrangement relative to each other, so that the wire thrust can be absorbed. The plate 51 is made of a water-repellent, plastics capable of absorbing the wire pressure, preferably of sintered low-pressure polyethylene with a high molecular weight, e.g. one million. On its leading edge 56 and on its trailing edge 57 the plate 51 is provided with oxide ceramic strips 58 and 59 respectively, which protect these high-stress edges against wear. The oxide ceramic strips 58, 59 have polished surfaces and are seated in corresponding recesses of the plate 51 in soch a manner that their surfaces cooperating with the wire are flush with the similar surfaces of the plate 1. The onrunning and offrunning edges 110 and 111 respectively of the slots 53 are analogously lined with oxide ceramic strips 112, 113, whose shape and arrangement are similar to those of the strips 58, 59. The butt joints of all strips 58, 59, 112, 113 extend obliquely to the direction a of wire travel, thus avoiding marking the pulp. The butt joints 114 on the onrunning edges of slots 53 are expediently also offset relative to the butt joints 115 on the offrunning edges of slots 53.

In the modified embodiment shown in Fig. 20 the slots 53 extend obliquely to the direction a of wire travel. Here, the slots are divided into groups, and the slots of each group are inclined at the same angle, but adjacent groups are oppositely inclined relative to the direction a of wire travel. In the right-hand group of slots 53 of Fig. 20, oxide ceramic strips 112, 113 are seated into the material of plate 51, which cover the onrunning and offrunning edges respectively of the slots 53. These strips 112, 113 may be made in a single piece, since the width of plate 51, in the direction a of sieve travel, generally does not exceed 50 to 60 cm, so that the length at which single-piece oxide ceramic strips can be produced with acceptable distortion will not be exceeded.

In the left-hand group of slots 53 of Fig. 20, the edges of the slots 53 are also formed by oxide-ceramic strips in the regions of the slot ends, as indicated at 121, but these strips cover only the slot-end regions and do not extend over a substantial portion of slot length. In this manner, even such complicated shapes can be produced with acceptable warping. Furthermore, in contrast to right-hand portion of figure 20, the arrangement is so conceived that the webs of plate 51 which extend between adjacent slots 53 are covered with integrally formed oxide ceramic strips 122, each of which abuts on the adjoining oxide ceramic elements 121. It is to be noted that the resulting joints do not extend parallel to the direction a of wire travel. This arrangement of elements 121 could be used with a plate having transversely extending slots.

Accordingly, in the case of the left-hand group of slots of Fig. 20, the entire surface portion of plate 51 is covered by oxide ceramic elements in the region of the slots. However, as Fig. 21 shows, the entire surface area of plate 51 which comes into contact with the wire or with the felt can be covered with oxide ceramic strips. To this end, the oxide ceramic strips 58, 59 arranged on the leading edge 56 and on the trailing edge 57 are enlarged in such a manner that they reach to the ends of the slots 53. In order to avoid complicated round shapes in the oxide ceramic elements, the slots are not rounded at their ends but are bounded by straight lines, and only the resulting corners are very slightly rounded. In this manner, practically the whole of the edge zones of slits 53 can be covered by strip-shaped oxide ceramic elements 122, each of which abuts on the oxide ceramic strips 58, 59.

The support plate 51 need not be formed as a single piece, but can be assembled of individual segments which are laid one beside the other and are screwed together. This variant is indicated by broken lines in Fig. 20. In order to avoid markings on the pulp, the butt joints 138 of the individual segments are inclined by about 60° relative to the direction a of wire travel. The screw connection of the segments with each other has been omitted from the drawing for the sake of simplicity, being known per se.

Figs. 22 and 23 show two modified constructional forms of the plate, in section perpendicular to the longitudinal direction of a slot. The slots 53 extend obliquely relative to the plate surface 116, so that the angle formed on the leading edge 110 is smaller than 90°. By these sharp edges the drops adhering to the underside of the wire are cut off as with a knife and projected into the slots 53. According to Fig. 22, the thickness of the oxide ceramic strips 112, 113 as measured perpendicularly to the plate surface 116 is only a fraction of the thickness of plate 51, so that material can be saved. The strips 112, 113 are seated in corresponding grooves 117, 118 of plate 51, said grooves extending over the entire length of the plate. The strip surfaces 119 which border the slots 53 extend flush with the slot walls 120.

Fig. 23 shows a modified embodiment in which the strips 112, 113 are standing on edge, so that their section contributes to the stiffening of plate 51.

The arrangements of the oxide ceramic strips as shown in Figs. 22 and 23 can of course also be applied in the same manner to plates provided with vertical instead of obliquely extending slots. Furthermore it is also possible to provide additional oxide ceramic strips 139 (Fig. 23), which do not extend in alignment with the slot walls but are sunk into the webs 140 formed between the slots, thereby achieving a further stiffening of these webs.

The oxide ceramic elements or strips can be cemented or fastened in any other suitable manner to the support material. It will be expedient, however, to provide for a limited relative displacement between the material of the support plate 51 and the oxide ceramic strips, in order to allow for the difference between the respective thermal expansion characteristics. To this end, according to Fig. 24, platelets 123 e.g. of aluminium, steel, are cemented to the bottom surfaces of the strips 58, 112, 113 by means of an epoxy adhesive. To these platelets 123 pins 124 are welded or screwed, which pass with play through elongated slots 125 of the support plate 51. On their free ends the pins have a threaded portion on which nuts 126 are screwed, which bear on the bottom surface of the plate 51 over interposed washers 127. This connection enables the strips 18, 112, 113 to execute a limited movement in their longitudinal direction relative to the plate 51, whereby the thermal stresses appearing can be relieved.

A variant of this arrangement is illustrated in Figs. 26 and 27. The bottom surface of the oxide ceramic strip 113 has an inwardly widening, preferably T-shaped recess 128, into which screws 129 with washers 130 engage. These screws 129 carry on their other ends nuts 131, which bear through washers 132 on the bottom surface of a strip 133. The screws 129 pass through elongated slots 134 of the strip 133, whose form is similar to that of the elongated slots 125 (Figs. 24 and 25). The strip 133 has on its covering surface a longitudinally extending projection 135, which engages into the recess 128 of the oxide ceramic strip 113. The strip 133 is further provided with apertures 136 offset relative to the slots 134, accommodating sunk screws 137, by means of which the strip 133 is screwed fast to the plate 51.

Fig. 28 shows a suction-bar construction, in which a sheet-metal trough 141, which is connected in a known manner by means of a conduit 142 to a vacuum source, carries a frame 143, which in turn is covered by several strips 144 extending over the entire width of the machine. These strips 144 define draining slots 53. As described in connection with the preceding figures, each of the strips 144 is lined with oxide ceramic elements 113. The individual strips, 144, made e.g. of sintered low-pressure polyethylene, are held at a distance from each other on both ends of the trough 141 by means of spacers 145 and are screwed together with the latter to form a slotted, plate-shaped component.

Fig. 29 shows an oxide ceramic strip 62 mounted longitudinally displaceable or in an expansion-compensating manner on a bar-shaped support 61 made of a water-repellent, dimensionally stable plastics such as sintered low-pressure polyethylene, said strip 62 having to this end on its bottom surface 63 a longitudinal groove 64 extending over its entire length, which widens inwardly to have a T-shaped cross-section. The support 61 is provided with several elongated slots 65 distributed over its length, each of said slots

65 extending along the support. The slots 65 traverse the support 61 from its plane covering surface on which the bottom surface of the oxide ceramic strip rests, to a longitudinal recess 66 in the bottom surface of the support 61. In each longitudinal slot 65 a bolt 67 can glide, which bolt serves for fastening the oxide ceramic strip 62 to the support 61. Here, the bolt head 68 rests over an interposed washer 69 on the inward-projecting flanges 70 of the oxide ceramic strip. On the bolt 67 a nut 71 is screwed, which bears, over interposed resilient pieces, e.g. two Belleville-washers 72 on a washer plate 73 resting on the oxide ceramic strip 62. If the oxide ceramic strip 62 expands differently from the support 61, then the bolts 67 slide in the elongated slots 65, which is facilitated by the resilient washers 72.

Since the fastening elements which attach the oxide ceramic strip 62 to the support 61 engage into said strip 62 from below, the surface 74 of the strip cooperating with the wire or with the felt remains completely smooth, so that the frictional resistance is not increased and the surface 74 is free of recesses or the like for fastening screws in which pulp particles could settle out.

Figs. 30 and 31 illustrate the attachment of the support together with the oxide ceramic strip to the front-end face of a suction box cover 75, showing a suction orifice 76. The support 61 is fastened to the suction box cover 75 by means of bolts 77 which are screwed into threaded bores 78 of said suction plate. Each bolt 77 passes through a vertically extending slot 79, which rises from the bottom surface of the support 61 over a substantial portion of its height. By this means, the support 61 can be made fast at various heights on the suction-box cover 75, so that even after possible reworking of the contact surface 220 of the suction-box cover 75 cooperating with the wire, the surface 74 of the oxide ceramic strip, which cooperates with the wire, remains in alignment with the surface 220. The bolts 77 are in this case arranged in recesses 221 of the support 61 and are offset relative to the bolts 67 which secure the oxide ceramic strip 62 to the support 61. (Fig. 30). In order to make possible the elevational displacement of the support 61 together with the oxide ceramic strip 62, the front-end face of the suction plate 75 is provided with a corresponding recess 222.

The oxide ceramic strip 62 is subdivided longitudinally into discrete elements, forming butt joints. However, the joint 223 extends obliquely to the direction of wire travel 224 (Fig. 29) or has the shape of an arrow in order to avoid marking the wire or the pulp.

In the embodiment of Fig. 31, the support 61 is provided on its covering surface with a longitudinally extending bar - shaped shoulder 225, which engages into the groove 64 of the oxide ceramic strip 62 and guides the latter longitudinally.

Since by reason of manufacturing tolerances or the like the support could be out of true with its covering surface, the ends of each segment of the oxide ceramic strip 62 have interposed shims 226, which provide the necessary elevational adjustment.

In the modified embodiment of Fig. 33, two or more bolts 67 are combined into a bridge by a crosspiece 227 extending along a recess 64 of the oxide ceramic strip 62. In this manner, the oxide ceramic strip 62 will be anchored not merely over short sections of its length, but over a substantial portion of its length.

In the embodiments hitherto described, the bolts 67 secure the individual elements of the oxide ceramic strip independently of each other. By contrast, in the modified embodiments of Figs. 34 and 35, a threaded bolt 67 is arranged in the region of the butt joint 223 between two adjacent elements of the oxide ceramic strip. According to Fig. 34, the upper end of the threaded bolt 67 is connected with a spring clip 228 of two-armed construction, one arm of which engages in the T-shaped recess 64 of the strip 62. This spring clip 228 can be formed of a suitably bent metal band.

The embodiment of Fig. 35 differs from that of Fig. 34 only in that the spring clip 228 is replaced by a rigid crosspiece 229, which engages into the ends of the recesses 64 of the adjacent segments of the oxide ceramic strip 62.

In the embodiment illustrated in Figs. 36 and 37, the oxide ceramic strips are secured on the support 61 not by a threaded bolt 67 but by means of a tension band 230. This tension band 230 is placed into the T-shaped recess 64 of the oxide ceramic strip 62 and is supported on a clamping member 231, which rests on the inner faces of the flanges 70 of the oxide ceramic strip 62. These flanges 70 are finished in the end regions of each strip element, so that rounded zones 232 (Fig. 36) are formed, over which the tension band 230 is extended downwards, where it contacts from below a bolt 233 screwed into the support base 61. The two ends of the tension band 230 are made fast on the two sides of the machine in any suitable manner, for example by means of a turnbuckle or the like. The tension band 230 is advantageously constituted by a flexible steel band.

In the embodiments illustrated in Figs. 29 to 37, the oxide ceramic strip 62 had to be provided in its bottom surface with a groove 64. This is avoided in the embodiment of Fig. 38, in which the bottom surface of the oxide ceramic strip is flat. On this flat bottom surface metal platelets 234 are cemented by means of an epoxy adhesive at intervals corresponding to the desired spacing of the threaded bolts 67; the latter are then welded to these platelets and their resilient securing is effected in the same manner by means of nuts 71 and resilient shims 72 as described in connection with Figures 29—37.

With very long suction box covers or the like (as measured across the direction of wire travel), the differences in thermal expansion between the support material and the oxide ceramic material can attain considerable magnitudes. In order to avoid gap formation between adjacent segments of the oxide ceramic strip 62 when the thermal expansion coefficient of the support 61 is greater than that of the oxide ceramic strip 62, the segments of the latter, as shown in Fig. 39, are pressed against each other by means of springs 235, which are supported at one end on the front edge 236 of the outermost strip segment 62, and on the other end are supported, if required adjustably, on the machine frame 237. In order to allow the sometimes considerable relative displacements of the bolt 67 in relation to the material of support 61, the bolts 67 slide in correspondingly long slots 65.

As an alternative to the construction illustrated in Fig. 39, there may be employed the variant shown in Figs. 40 and 41. If the thermal expansion coefficient of the support (not illustrated) is greater than that of the oxide ceramic strips 62, then in the course of the expansion of the support gaps may form in the region of the butt joints of adjoining oxide ceramic strips 62. This would free the inherently sharp edges or corners of the hard oxide ceramic material and could thus lead to a damage of the wire or felt. In order to reliably avoid this even gaps 238 (Fig. 41) form between adjoining oxide ceramic strips 62, a tie member 239, preferably consisting of the same oxide ceramic material as the strip, is embedded into the material of the support in front of the joint of the adjacent oxide ceramic strips 62, as viewed in the direction a of wire or felt travel. The wire or felt onrunning edge 241 of the tie 239 as well as its lateral edges are ground down so, as to slope towards the rim. so that the wire or the felt gradually runs up on the tie 239 and consequently cannot be caught thereon. Expediently, the upper edge 242 is likewise ground down at the joint of each oxide ceramic strip 62, so that it is not contacted by the wire or felt sliding over the tie 239. The latter is preferably formed of a single piece and extends transversely to the direction 224 of wire travel only so far as necessary for covering the region of the gap 238 formed. In this manner, damage to the wire or to the felt is reliably avoided even if large gaps should form.

Figs. 42 and 43 show modifications of the embodiment of Fig. 39 as applied to a suction- or draining bar. The upper ends of all threaded bolts are welded fast to a steel clamping bar 227, which extends over the entire length of the oxide ceramic elements 2 arranged one behind the other. Fig. 42 shows that the clamping bar 227 is provided at its two ends located outside the two ends of the wire or felt width b with welded-on threaded bolt like extensions 243, on the threaded ends of which nuts 244 are screwed. These nuts 244 bear via spring plates 245 or rubber blocks carried by the threaded bolts against the lateral boundary surfaces 246 of the two outermost oxide ceramic elements 62. By this means, the oxide ceramic elements 62 fitted on the clamping bar 227 and held down by the latter on the support 61 are pressed against each other, so that the abutting ends of adjacent elements 62, e.g. 223, are free of gaps.

To prevent the support 61 from entraining the elements 62 by frictional contact in case of expansion, the bottom surfaces 63 of the oxide ceramic elements 62 and the top surface 247 of the support 61 located opposite thereto are given a smooth finish, e.g. by polishing. The smoother the cooperating surface elements, i.e. the smaller their relative coefficient of friction, the lower will be the spring pressure required to hold the individual elements 62 in tight contact with each other. To avoid a deterioration of spring pressure owing to excessive expansion of the clamping bar 227, the latter has a coefficient of thermal expansion which at most equals that of the oxide ceramic elements.

The threaded bolts 243 could also be connected with the clamping bar 227 by screwing said bolts into corresponding threaded bores of the clamping bar 227.

The modified embodiment shown in Fig. 43 differs from the embodiment of Fig. 42 only in that the support 61 is constituted by a square bar while a plastics band 248 measuring 1 to 2 mm in thickness is placed between the support 61 and the elements 62. This plastics band forms an elastic support for the oxide ceramic elements 62, so that the latter can be pressed resiliently downwards by tightening the nuts 71. Consequently, the resilent washers 72 of the constructions according to Fig. 42 can be omitted and replaced with ordinary washers 72'. The plastics band 248 furthermore constitutes a vacuum seal, which prevents a breakdown of the vacuum of the suction device at the outermost suction bars. Lastly, the plastics band also constitutes a thermal insulator between the oxide ceramic elements 62 and the support 61.

The plastics band 248 can also be formed in such a manner, e.g. with a thickness of 3 mm, that it absorbs the expansion differences between the oxide ceramic elements 62 and the support 61, i.e. so that the individual layers of the plastics band slide upon each other. Particularly suitable for this purpose are correspondingly thick plastics bands made of at least two polyols, in particular diols and/or at least two polyisocyanates, in particular diisocyanates, e.g. polyurethane.

The bolts 67 traverse the longitudinal slots 65 in the support 61 with play, to avoid being entrained by the support when the latter is expanding.

WHAT WE CLAIM IS:—

1. A device for extracting water from the paper or pulp in a paper-making or wet-pulp machine, said device having an upper surface for sliding cooperation with the wire or felt of the machine, at least a substantial part of the surface being formed by elements made of hard oxide ceramic material, which elements are embedded into or supported by support means made of a water-repellent non-brittle synthetic plastics material which is softer than the oxide ceramic material.

2. A device according to claim 1, wherein the elements are spaced from each other and the support means is located in the spaces therebetween.

3. A device according to claims 1 or 2, wherein the elements are interchangeably fitted in the support means.

4. A device according to any one of claims 1 to 3, wherein the elements are elevationally adjustable in the support means.

5. A device according to claim 4, wherein the elements are bounded by cylindrical surfaces and are fitted in the support means by screw threads.

6. A device according to any one of claims 1 to 5, wherein the elements are in the form of sleeves surrounding a suction orifice.

7. A device according to any one of claims 1 to 6, wherein the elements are mushroom-shaped having a surface part having a first cross-sectional area and a lower part having a smaller cross-sectional area.

8. A device according to any one of claims 1, 2, 6 and 7, wherein the support means is connected to the elements by casting or sintering.

9. A device according to claim 1, wherein some of the oxide ceramic elements are elongated and are arranged obliquely to the direction of travel of the wire or felt.

10. A device according to claim 1, wherein a row of butt-jointed oxide ceramic elements is provided on the leading and/or trailing edge of the said surface, and a second row of butt-jointed ceramic elements is also provided, the butt joints of the said first row of oxide ceramic elements being offset relative to the butt joints of the said second row of oxide ceramic elements.

11. A device according to claim 1, wherein the support means is a rigid, integrally formed support plate and is provided with slots for evacuating the water, which slots are arranged obliquely or perpendicularly to the direction of travel of the wire or felt and wherein at least the leading edges of the slots are constituted by oxide ceramic elements carried by the support plate.

12. A device according to claim 11, wherein the oxide ceramic elements are strips which, viewed perpendicularly to the direction of travel of the wire or felt, abut each other and the butt joints between adjacent strips extend obliquely to the said direction of travel.

13. A device according to claim 11 wherein the surface between the adjacent slots is also formed of oxide ceramic elements.

14. A device according to claim 11 wherein the oxide ceramic strips are positioned on edge.

15. A device according to any one of claims 11 to 14, wherein the axes of the slot apertures extend obliquely to the plate surface and the boundary surfaces of the oxide ceramic strips which form the lining of the slot apertures are parallel to the slot axes.

16. A device according to any of claims 1 to 3 wherein the oxide ceramic elements are elongated and these elements and/or the support means are provided with a groove and fastening elements are provided to locate loosely the elements to the support means.

17. A device according to claim 16 wherein the groove has an inwardly widening T-shaped cross-section.

18. A device according to claim 17 wherein a groove is provided in the bottom surface of each element and the fastening members for engaging in this groove are supported on the support means from below.

19. A device according to claim 18 wherein the fastening elements are bolts which engage in the groove.

20. A device according to claim 19 wherein two fastening elements are attached to a clamping bar placed in the groove.

21. A device according to claim 16 wherein the groove extends over the entire length of each elongated element and accommodates a clamping bar which is held down by a tension band passed through said groove and fastened to the support and to the machine.

22. A device according to any one of claims 16 to 19 wherein the fastening elements are arranged at the butt joints of two adjacent oxide ceramic elements and hold down said oxide ceramic elements in pairs.

23. A device according to claim 16 wherein bolts traversing the support means with play are fixed on the bottom surface of the oxide ceramic elements, these bolts carrying nuts which bear against the bottom surface of the support means.

24. A device according to any one of claims 1 to 3 wherein the oxide ceramic elements are elongated and arranged end to end and there is provided means for resiliently pressing these elements against each other.

25. A device according to claim 20 wherein the clamping bar traverses a plurality of oxide ceramic elements located one beside the

other across the direction of wire or felt travel and resilient means bears against the clamping bar so that the resilient pressure acting from both sides is greater than the force required for displacing an oxide ceramic element on the support means.

26. A device according to claim 25 wherein the clamping bar is provided with a threaded portion at each end thereof and a nut is provided in screw-threaded engagement with each said portion and also including two resilient means supported by the two nuts respectively and arranged to bear against the two end walls respectively of the said plurality of oxide ceramic elements.

27. A device according to claim 26 wherein the resilient means are constituted by spring plates or rubber blocks.

28. A device according to any one of claims 25 to 27 wherein the clamping bar consists of a material with thermal expansion coefficient not higher than that of the oxide ceramic elements.

29. A device according to any one of claims 25 to 27 wherein the adjoining surfaces of the oxide ceramic elements and of the support means are smoothed, e.g. polished, in order to obtain a low coefficient of friction.

30. A device according to any one of claims 25 to 28 wherein between the oxide ceramic elements and the support means there is located an elastic band of synthetic plastics material.

31. A device according to claim 1 including two adjacent oxide ceramic elements having a butt joint and, in front of these elements as viewed from the direction of travel of the wire or felt, there is provided a further oxide ceramic element having a rounded or bevelled leading edge viewed from the said direction of travel of the wire or felt.

32. A device for paper-making or wet-pulp machines as claimed in claim 1 and substantially as described above with reference to the accompanying drawings.

MARKS & CLERK,
Chartered Patent Agents,
Agents for the Applicant(s).

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1232681 COMPLETE SPECIFICATION

11 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

FIG. 1

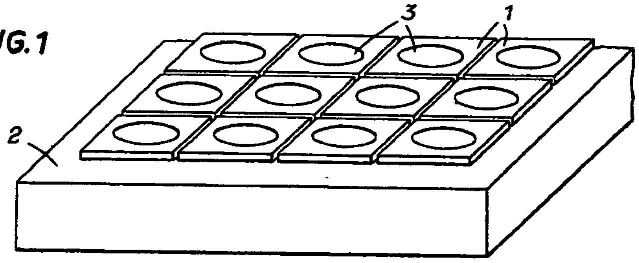


FIG. 2

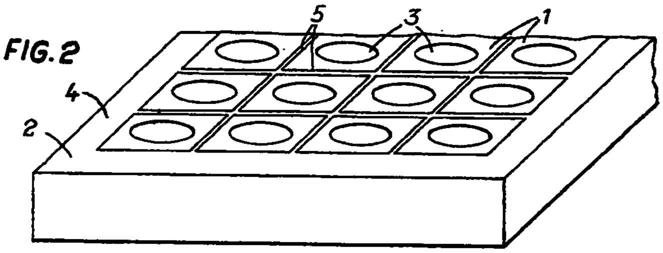


FIG. 3

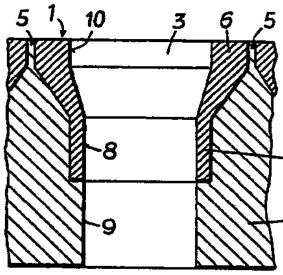


FIG. 4

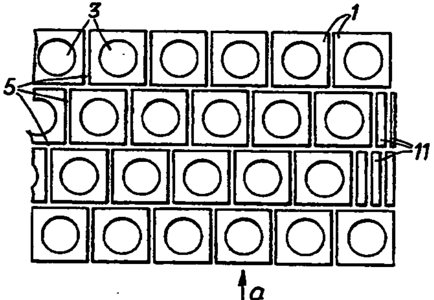


FIG. 5

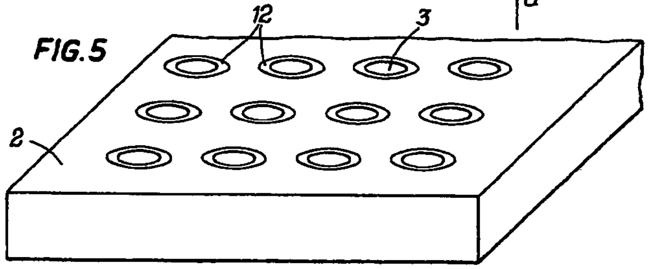


FIG. 6

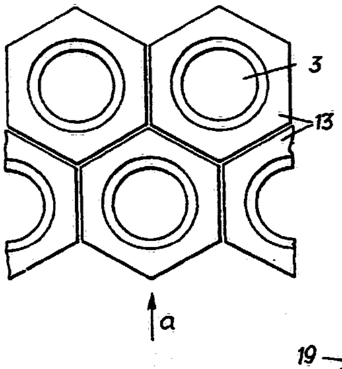


FIG. 7

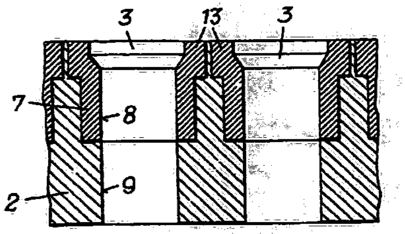


FIG. 8

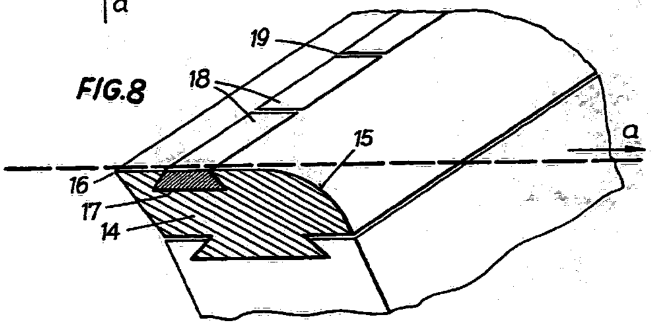


FIG. 9

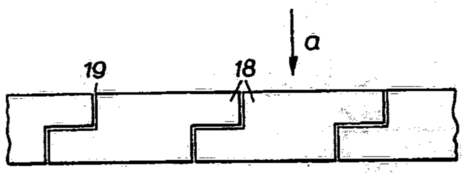


FIG. 10

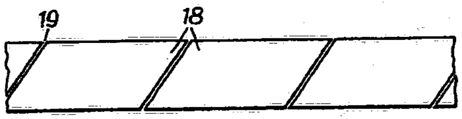


FIG. 11

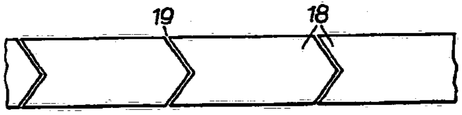


FIG. 12

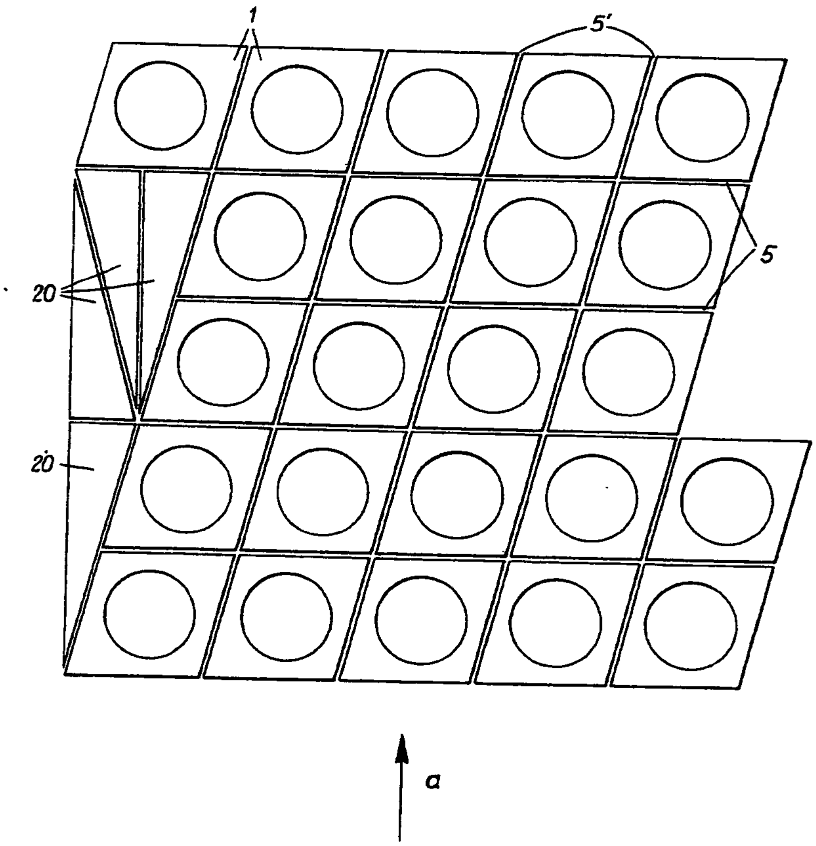


FIG. 13

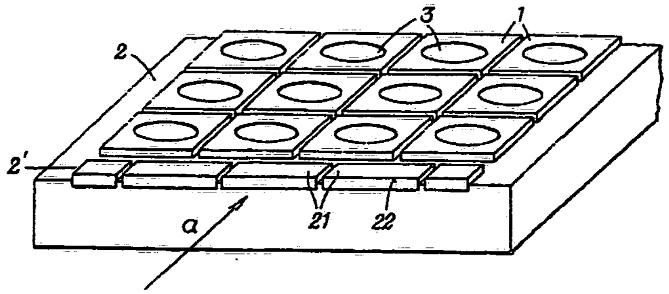


FIG. 14

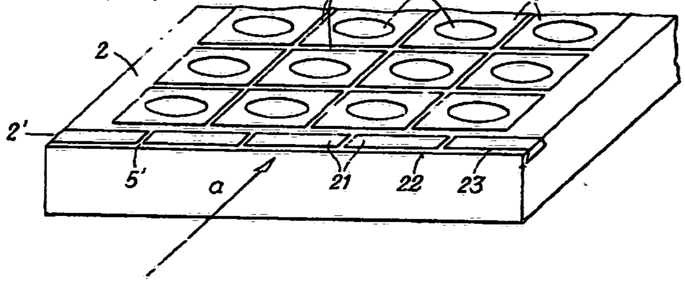


FIG. 15

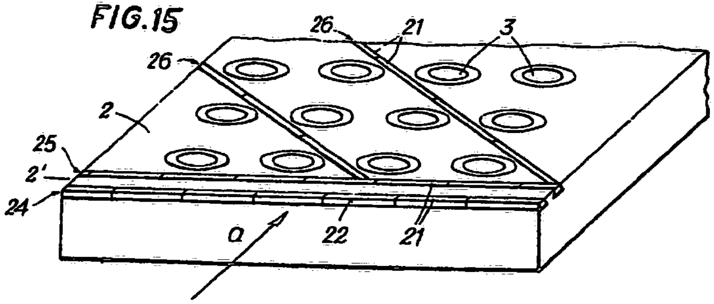


FIG. 16

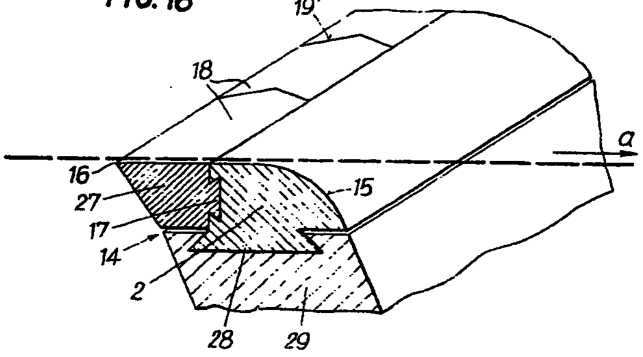


FIG. 17

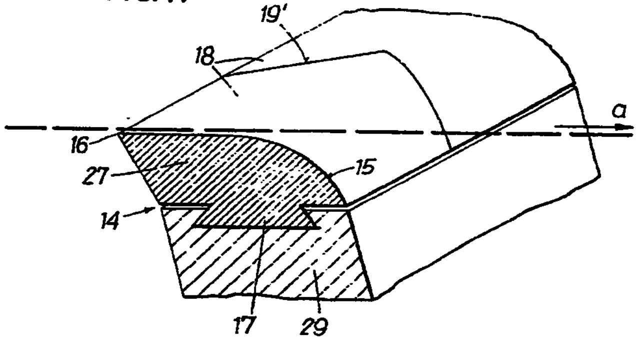


FIG. 18

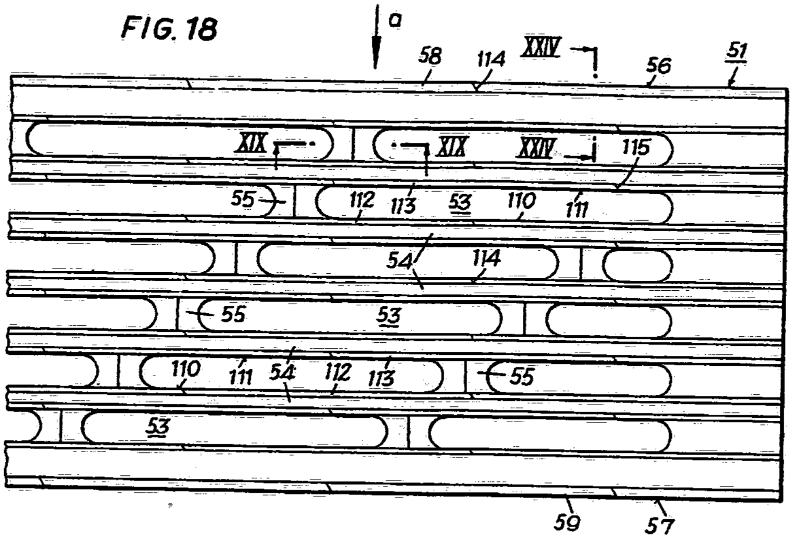


FIG. 19

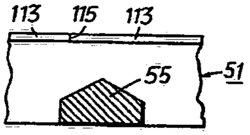


FIG. 20

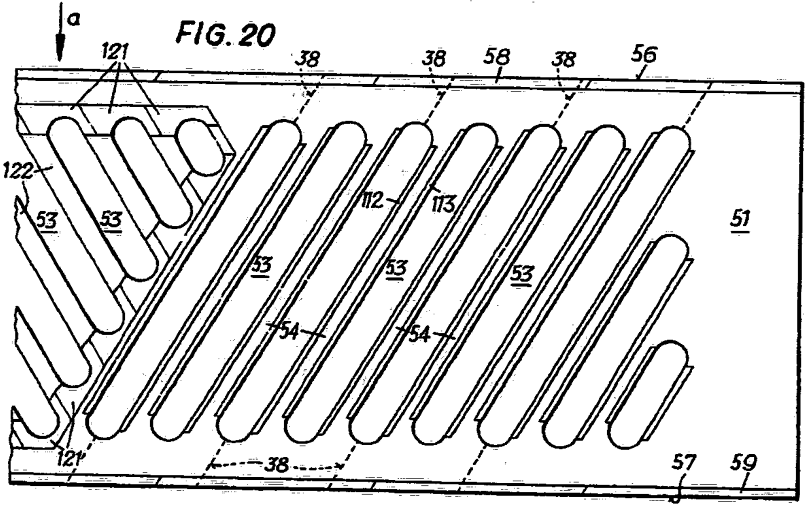
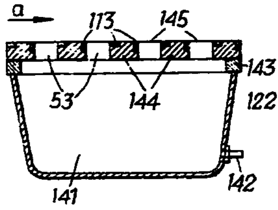


FIG. 28



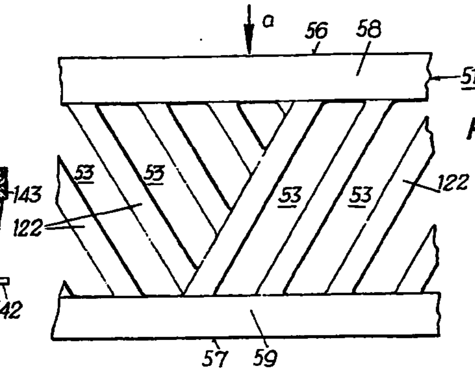


FIG. 21

FIG. 22

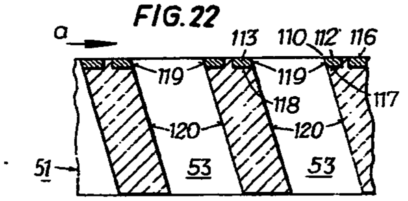


FIG. 23

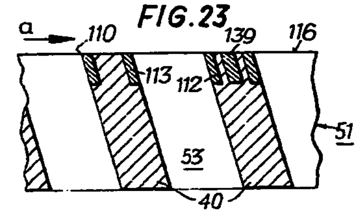


FIG. 24

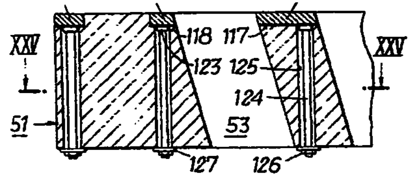


FIG. 25

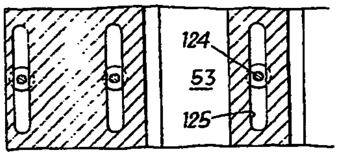


FIG. 26

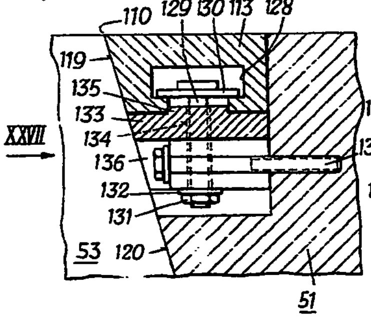


FIG. 27

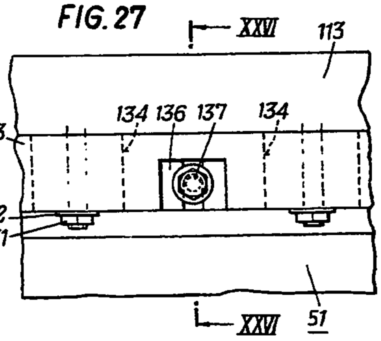


FIG. 29

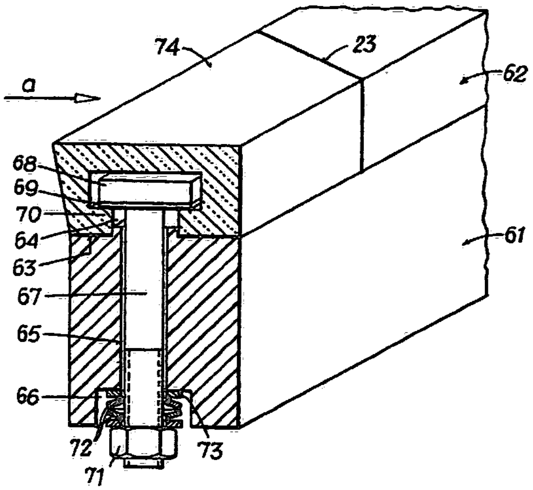


FIG. 30

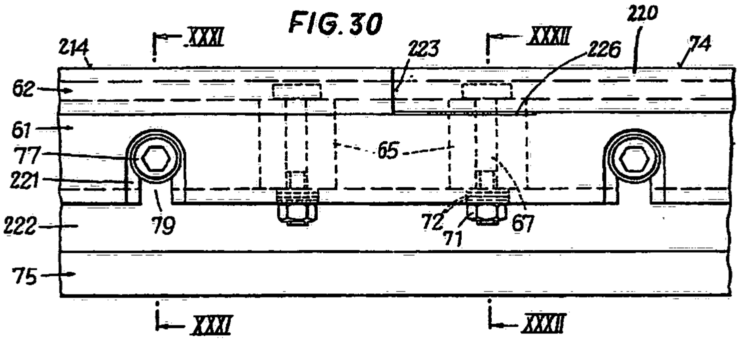


FIG. 31

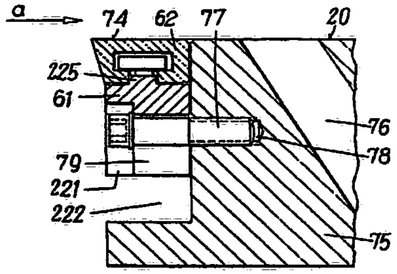


FIG. 32

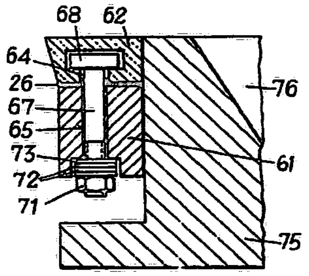


FIG. 33

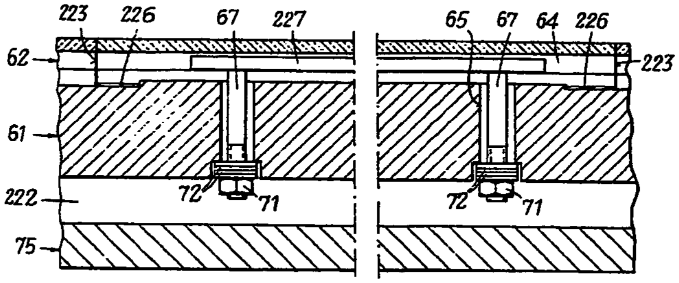


FIG. 34

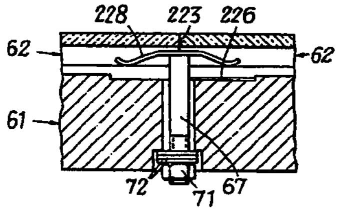


FIG. 35

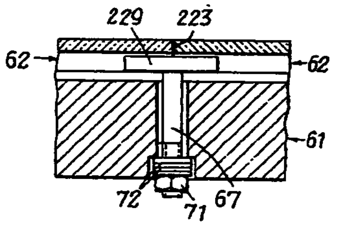


FIG. 37

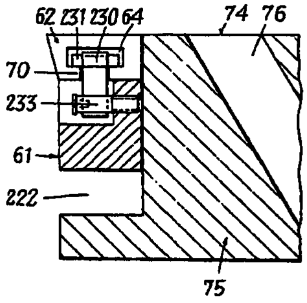


FIG. 36

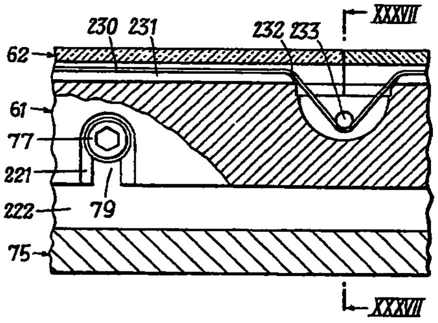


FIG. 38

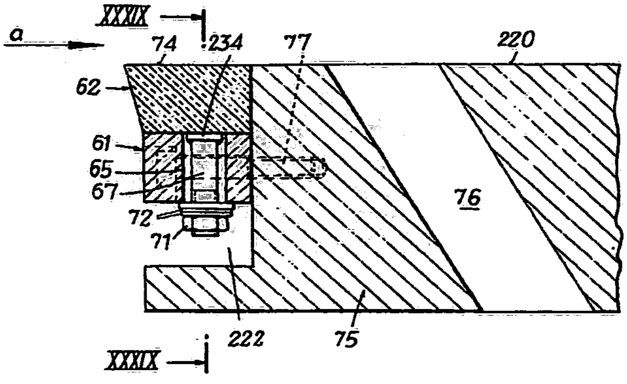


FIG. 39

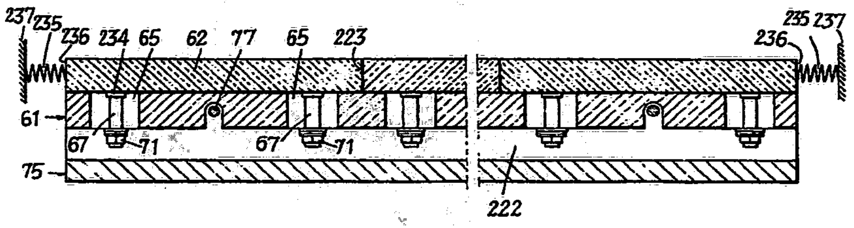


FIG. 40

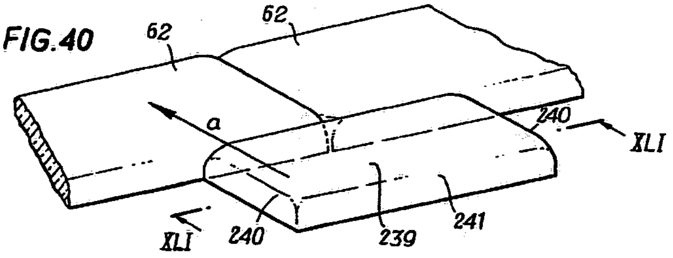
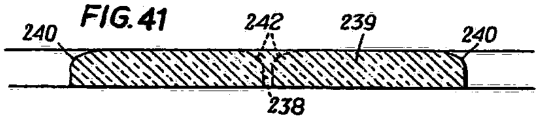


FIG. 41



1232681 COMPLETE SPECIFICATION

11 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 11

FIG. 42

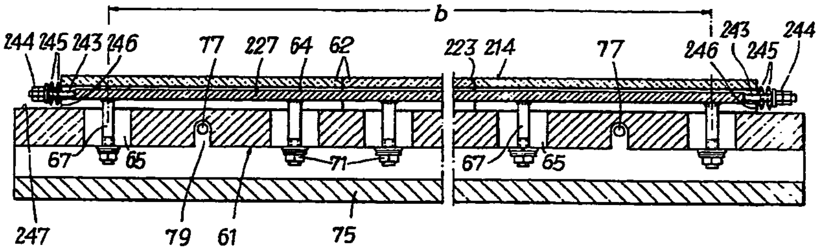
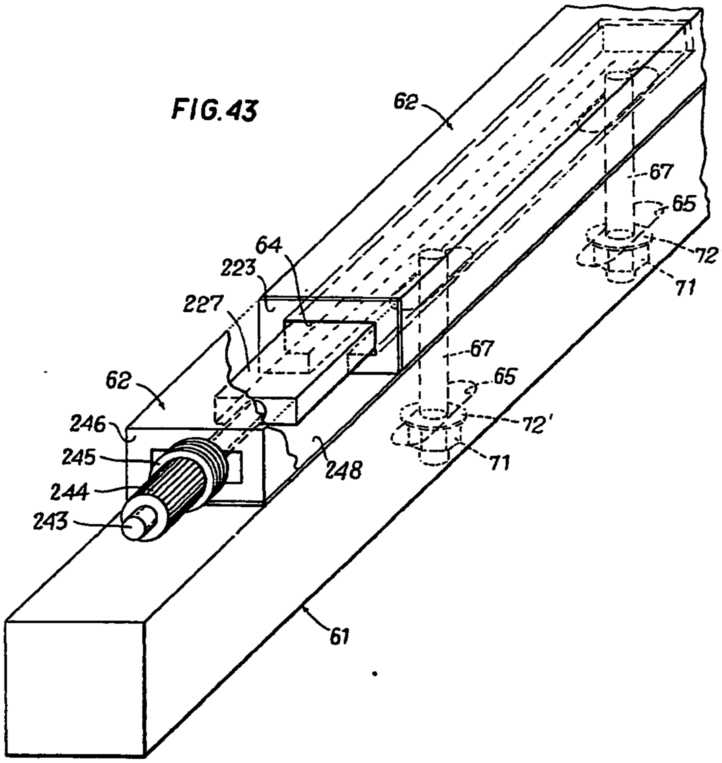


FIG. 43



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